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System on Temperature Control of Hollow Fiber Spinning Machine Based on LabVIEW

Zhang Mingle[a], Yun Jintian[a,*], Jin Guoguang[a], Liu Gang[a]

[a] *Tianjin Polytechnic University, Tianjin China 300160*

Abstract

In this paper, temperature controller and transducer are applied to the system for temperature control of hollow fiber membrane based on LabVIEW software. By rs485 communication, temperature and rotational speed are monitored and controlled in real time. And the communication instruments are introduced. Some combined units are used to reduce the system response time. Combining LabVIEW software with serial communication technic, the automation level of hollow fiber spinning machine and the sensitivity of date acquisition and monitoring is greatly improved.

Keywords: LabVIEW; Temperature controller; Transducer; RS485 communication.

1. Introduction

With the development of society ,the traditional water purification processes ,such as chlorination and ion exchange , have been no longer met the requirements of the low investment, low running costs, but high reliability. Therefore, the development of new technology and new product is an important mission. The hollow fiber membrane technology with lower power consumption, efficiency is widely recognized in field of water treatment.

In the process of hollow fiber, the temperature is an important physical parameter, which is monitored and controlled in real time. In the paper, by rs485, temperature and rotational speed are monitored and controlled in real time. At present, VB and VC are used as the software development of serial communication generally. And LabVIEW, which is developed by National Instruments Corporation, is a graphical programming language that uses icons instead of lines of text to create applications [1]. In

* email: tjpu2008@sina.com

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contrast to text-based programming languages, where instructions determine program execution, LabVIEW uses dataflow programming, where the flow of data determines execution [3].

2. Serial port

The RS232 is a standard developed by the Electronic Industries Association (EIA) and other interested parties [2]. It is a way to communicate with PC and devices. The rs232's shortcomings, such as low transfer rate and short transmission distance, are solved by rs485, which use wire differential transmission. Its fastest transfer rate is 10 Mbps, and the longest transmission distance is 1219m.

Temperature digital controller and transducer are main devices in the system. As they are built-in rs485 interface and PC is rs232 interface, the converter should be introduced to communicate with devices and PC.

3. Communication instruction

RKC digital controller and Fuji transducer are applied to the system. The different communication instructions are used. Fuji transducer has Modbus RTU and Fuji common transducer instruction. The instruction, Modbus RTU, is selected. And RKC digital controller uses the polling/selecting method to establish a data link. The basic procedure is followed ANSI X3.28 subcategory 2.5,A4 basic mode date transmission control procedure.(Fig.1 shows polling sequence)

Device address	Identifier	ENQ

Fig.1 polling sequence

ENQ: this is the transmission control character which indicates the end of the polling sequence. Then, the host computer waits for response from the controller. (Fig.2 shows selecting sequence).

EOT	Address	STX	Identifier	Date	ETX	BCC

Fig. 2 selecting sequence

EOT: initializing of data link before selecting sequence；**STX**:the transmission control character which indicaters the start of the text；**EXT**:the transmission control character uesd to indicate text end；**BCC**:error detection using horizontal parity .it is calculated by horizontal parity.the calcualated way is to take off EX-OR(exclusive "or") of all character from next STX through ETX**.**

4. Serial port in LabVIEW

LabVIEW consists of front panel and block diagram. Front panel including input and display functions is the interactive interface. In block diagram, there are source codes to define and control the input and display functions in the front panel.

LabVIEW serial port function is VISA (Virtual Instrument Software Architecture). VISA is standard I/O application programming interface (API) used in programming without programming ability. VISA is a high-level API to control instruments by calling the underlying driver. VISA consists of six serial communication nodes, VISA Configure Serial Port, VISA Write, VISA Read, VISA Serial Break, VISA Bytes at serial port, VISA Close [4,5]. Serial communication requires four specified parameters: the baud rate of the transmission, the number of data bits encoding a character, the sense of the optional parity bit,

and the number of stop bits. These four parameters and to set master and slave's address are easily completed by Labview VISA.

5. Program design in LabVIEW

The hexadecimal transmission frame is used by transducer and temperature controller. And VISA Write input data form is string, which automatically convert to the sending form, U8 (ASCII character). VISA Read output data form also is string. The hexadecimal polling sequence was converted to string before sending to devices, and the string response sequence was converted to hexadecimal form [3]. The solution is to use "byte array to string" node and "string to byte array" node, or to change string nodes' normal display to hexadecimal display (the way shown as Fig3).

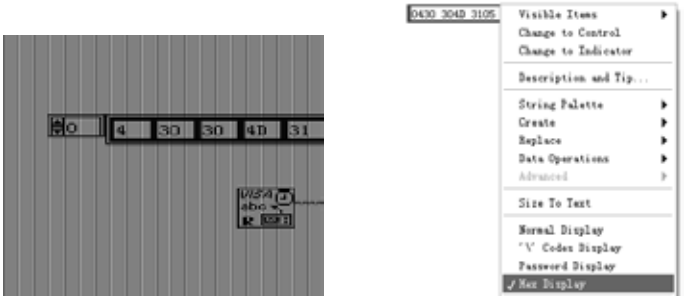

Fig.3 the converted solution

The system consists of eight RKC digital controllers and six Fuji transducers. As the rule of serial port communication, polling sequence is sent to slave, then slave send response. This course spends about 100ms. For temperature controller or transducer, there are three main functions to be achieved by communication. If each device and function is treated as an independent unit, the response time of the system would be longer. In the paper, some related functions are considered as a unit, which can reduce the system response time. The solution is shown in Fig.5 and Fig.6.In the paper, some related functions are considered as a unit, which cut the system response time. The solution is shown in Fig.5 and Fig.6.

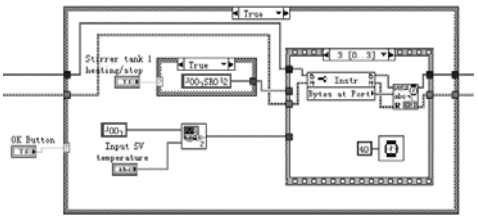

Fig.5 temperture controller controled unit

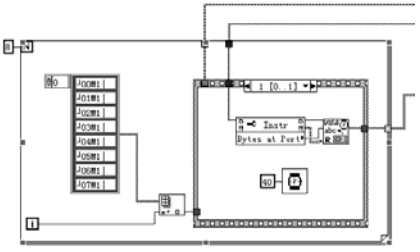

Fig. 6 polling temperature unit

Sub-VI is the LabVIEW sub programming. Its use may let the entire procedure structure with more levels. The sub-VI procedure is similar to the traditional text language. It may be used by other VI procedure [6]. This paper creates four sub-VI procedures. The block diagram of sub-VI on input SV temperature is shown in Fig.7

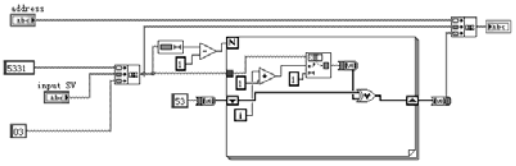

Fig.7 input temperature sub-VI

6. the Main program

Each slave's communication parameters, the baud rate of the transmission, the number of data bits encoding a character, the sense of the optional parity bit, and the number of stop bits are defined as the master's parameters. And the main program is shown in Fig.8.

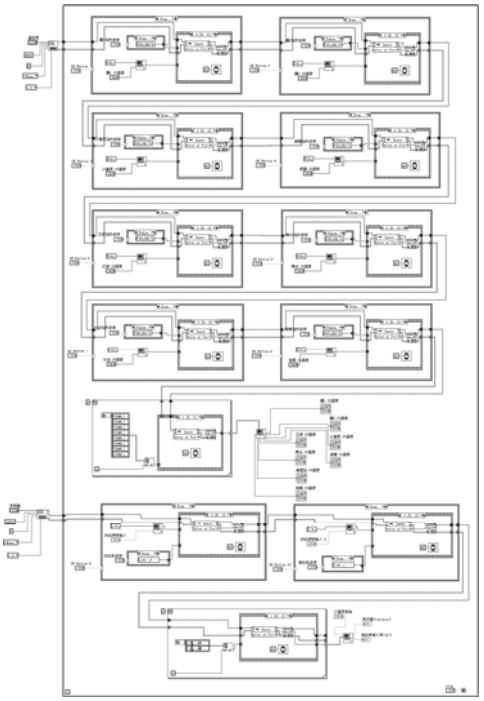

Fig.8 main program

7. Ending

In this paper, the system combining LabVIEW software with serial communication technic is realized. The temperature and rotational speed to be monitored and controlled in real time is achieved in this system. The automation of hollow fiber spinning machine is improved .The data acquisition and processing are done on the Master, which reduce the impact of operational errors and improve productivity. The system response time is greatly cut by use some combined units. This manufacturing system of hollow fiber membrane is applied to the production and practice. The sensitivity of date collection and monitoring were greatly improved.

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